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STUDIES ON NEW ZEALAND ELASMOBRANCHII. PART
VI. TWO NEW SPECIES OF *ETMOPTERUS* FROM
NEW ZEALAND

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No. 3 — *Studies on New Zealand Elasmobranchii. Part VI.*
*Two New Species of Etmopterus from New Zealand*¹

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Experimental line-fishing off New Zealand, for the purpose of adding to our knowledge of the deeper-water shark fauna of this region, has resulted in the capture of three specimens of *Etmopterus* representing two species apparently new to science. These specimens were caught off Kaikoura on the east coast of the South Island, by Mr. Richard Baxter, who, fishing from a 16 foot dinghy, collected one large brown specimen from 500 fathoms, and a small grey-black specimen from 200 fathoms in November, 1955. In February, 1956, a further grey-black specimen was caught in 100 fathoms. All captures were made close inshore, the submarine topography of the Kaikoura region being such that water 500 fathoms deep is found within 3 miles of the coast.

Although squaloid sharks are fairly well represented in the New Zealand fauna, no specimens of *Etmopterus* have been known, and geographically the nearest member of the genus is *E. molleri* (Whitley) 1939 of southern Australia. It is therefore of considerable interest that the two species of these luminescent sharks now known to be present should represent what are more or less the extremes of morphological diversity in the genus. The large brown specimen, here proposed as *Etmopterus baxteri* n.sp., in honour of Mr. Richard Baxter, is akin to *E. princeps* of the North Atlantic in its size — which exceeds that of most other species; in the uniform but random arrangement of the dermal denticles; in the noticeably small and rounded pectoral fins; in the rather plain colouration and inconspicuous pelvic flank mark; and in the high number of cusps on the upper teeth. The grey-black specimens, named here as *Etmopterus abernethyi* n.sp., for Mr. Fred Abernethy who has contributed greatly to the collection of New Zealand elasmobranchs, are closely allied to the Pacific species *E. lucifer*, *E. brachyurus* and *E. molleri*, and like them are small; with dermal denticles arranged linearly

¹ This study has been assisted by a grant from the Research Grants Committee of the University of New Zealand.

on the sides and upper surface of the trunk; with large and more angular pectoral fins; with an obvious colour pattern and conspicuous flank marks; and with a smaller number of cusps on the upper teeth.

Comparison of *E. baxteri* and *E. abernethyi* with other species of the genus, of which twelve are listed by Bigelow, Schroeder and Springer (1953, p. 238), though *E. molleri* (Whitley) 1939 should be added to these, has been greatly facilitated by the availability of specimens of *E. spinax*, *E. polli* and *E. princeps* provided by Drs. H. B. Bigelow and W. C. Schroeder, to whom I am also especially indebted for their generosity in supplying access to their manuscript key to the species.

ETMOPTERUS BAXTERI n.sp.

Figures 1 and 2

Study Material. Holotype, mature female, 742 mm. total length, Dominion Museum No. 1950, lined from 500 fathoms seven miles south of Kaikoura, New Zealand, by Mr. R. Baxter, in November, 1955.

Description. *Proportional measurements in per cent of total length:*

Trunk at pectoral origin: breadth, 12.7; height, 10.8

Snout length in front of: outer nostrils, 1.7; mouth, 8.4.

Eye: horizontal diameter, 4.0; vertical diameter, 2.7.

Mouth: breadth, 8.4; height, 1.4.

Nostrils: breadth (between inner corners), 3.1.

Labial furrow lengths: upper, 3.5; lower, 1.7.

Gill-opening lengths: 1st., 2.7; 3rd., 1.7; 5th., 1.7.

First dorsal fin: vertical height, 3.1; length of base, 5.7.

Second dorsal fin: vertical height, 4.0; length of base, 8.1.

Caudal fin: upper margin, 18.4; lower anterior margin, 10.2.

Pectoral fin: anterior margin, 7.5; width, 6.1.

Pelvic fin: anterior margin, 5.7; distal margin, 6.2; posterior margin, 2.2.

Distance from snout to: eye, 5.4; 1st gill-opening, 16.2; 5th gill-opening, 20.7; 1st dorsal, 33.4; 2nd dorsal, 65.5; upper caudal, 81.8; pectoral, 21.7; pelvic, 57.4.

Interspace between: 1st and 2nd dorsals, 26.0; 2nd dorsal and

caudal, 10.1; pelvic and subcaudal, 14.3.

Distance from origin to origin of: pectoral and pelvic, 35.7;
pelvic and subcaudal, 22.2.

Head depressed, wide, compact, and very large-eyed; trunk moderately stout, and compressed posterior to the pectorals. Height of trunk at origin of pectorals 7.5 in the length from snout tip to origin of subcaudal. Length of body measured to the cloaca, 62 per cent of the total length. Caudal peduncle little compressed and slender, and without lateral keels or precaudal pits.

Dermal denticles small, numerous, and in the form of conical thorns, slightly curved and directed posteriorly, and borne on four-angled bases. Each denticle carries six ridges, four of which are continuous with the ridges arising from the angles of the base, while two are intermediate ridges on the anterior face of the denticle and do not extend on to the base. Denticles from the head and fins similar to those from the trunk. The denticles are distributed uniformly but sparsely so that there are considerable interspaces between them where the skin is visible. Their arrangement is random, at least on the anterior two-thirds of the trunk, though towards the caudal peduncle and on the tail they are in more or less regular longitudinal rows. The pectoral, pelvic, dorsal and caudal fins are denticle covered almost to their margins, except for the ventral surface of the pelvic which has a wide, naked zone distally, and the web of the second dorsal on which the denticles are very sparse. Other naked regions of the body include the ventral surface of the tip of the snout; the upper and lower lips; the axil of the pectoral where the naked area is large and ovoid in outline, extending along the trunk well posterior to the fin when the latter is laid back, and also continued on to the upper surface of the fin itself as a wide band along the posterior margin; the axil of the pelvic and the entire upper surface of the base of this fin; the axil of the first dorsal where the naked area is small; and the axil of the second dorsal where the naked area is very extensive, reaching from in front of the origin of the fin to behind its posterior free tip. In all cases, the naked regions correspond with the lighter coloured areas on the trunk and fins. Within the dark area encompassed by the pelvic flank mark, the denticles are noticeably smaller

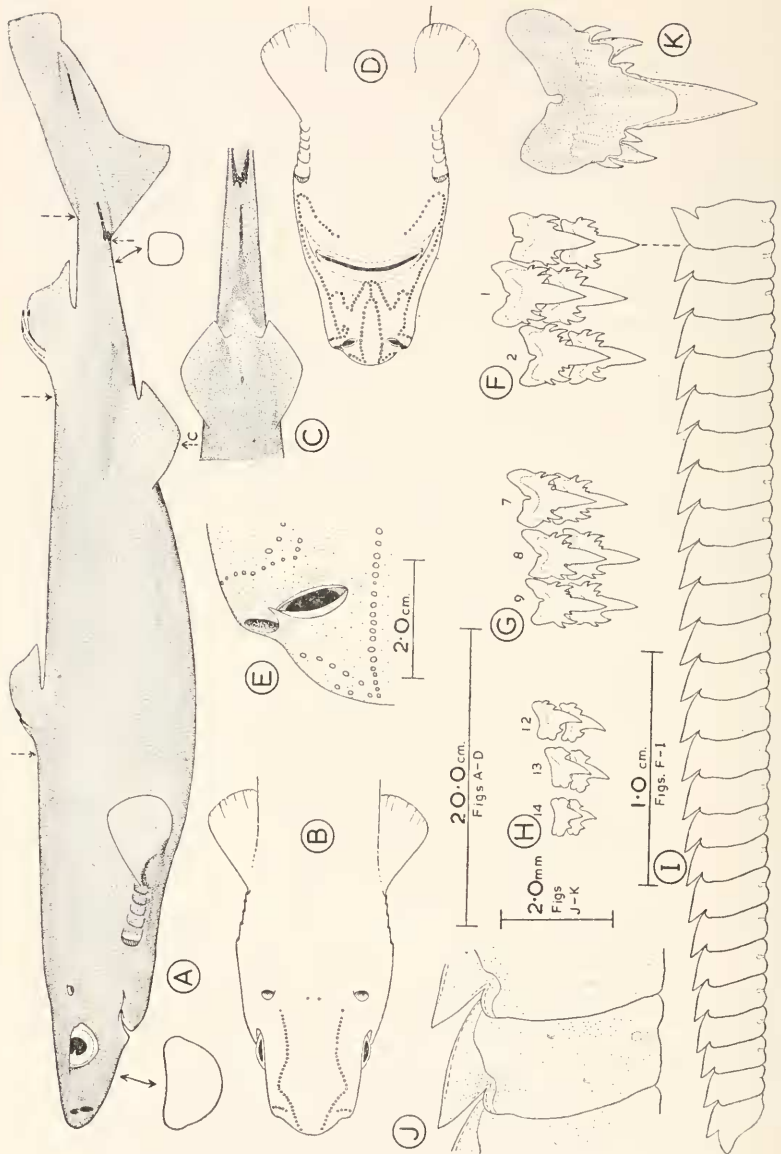


Figure 1. *Etmopterus baxteri* n.sp., holotype, 742 mm. total length. *A*, lateral view and insets of sections through snout and peduncle; *B*, dorsal view of head showing prominent lateral line pores; *C*, ventral view of peduncle; *D*, ventral view of head with pores as in *B*; *E*, left nostril; *F-H*, upper teeth from right side, row numbers indicated above; *I*, lower teeth, right side; *J*, 10th lower tooth, right side; *K*, 6th upper tooth, right side. (c = level of cloaca.)

than the adjacent ones, and also the tips of these denticles are directed ventrally rather than posteriorly as are the majority of the trunk denticles.

Head measured to first gill-opening 6.2 in the total length, and just less than half the distance from snout tip to first dorsal origin. Head noticeably broad, its greatest width at the level of the first gill-opening where it is 1.6 times the least fleshy interorbital width, the latter being equal to the preoral distance. Width of the head at the level of the nostrils is only slightly narrower than the interorbital width, so that the contours of the head between these levels are almost parallel. The snout tip is broadly rounded, and each nostril forms an abrupt step in the contour. The snout is thick, slightly wedge-shaped in profile, strongly depressed, and flat above as is the greater part of the head to the level of the spiracles. Length of snout measured to eye, 3.0 in the head. Eye very large, ovoid, 1.5 times as long as high, its horizontal diameter 1.3 in the snout. Spiracle large, its length 4.0 in the horizontal diameter of the eye, and placed just above the level of the dorsal margin of the eye, and behind it by a distance equal to about twice its own length. Gill-openings of moderate size and slightly oblique; each gill-opening is deeply emarginate, especially the first in which the tips of the gill-filaments are visible. Lengths of the gill-openings decrease from the first to the fourth, but with the fifth equal to the third. Length of the first gill-opening 1.7 times that of the fourth, and 1.5 in the horizontal diameter of the eye. Interspaces between the gill-openings decrease posteriorly, that between the first and second almost twice that between the fourth and fifth. Nostrils large, oblique, and well anterior on the venter of the snout. Each nasal aperture subdivided into an anteriorly directed, circular, anterolateral aperture and an ovoid posteromedial aperture by triangular nasal flaps. The anterior nasal flap is large, pointed, and external to the shorter, fleshy posterior flap. The posteromedial aperture is also margined in front and behind by a low membrane. Mouth broad, and only slightly arched, its width just greater than the preoral distance, and 1.9 in the length of head. The upper labial furrows moderately long, and deeply incised anteriorly, their length 1.4 in the distance from their anterior extremity to the symphysis of the upper jaw. The lower labial

furrows are shallowly incised and short, their length about half that of the upper furrows.

Teeth $\frac{14-1-14}{25-27}$, dissimilar in the two jaws. The upper teeth erect, each with a long, sharply-pointed, awl-shaped, smooth-edged major cusp flanked on each side by up to four small lesser cusps, and borne on a longitudinally-striated bifid base. Most of the upper teeth have three lesser cusps on each side of the major cusp, with the middle cusp of these three considerably larger than the others though not more than one-third the length of the major cusp. A few teeth near the centre of the jaw have four lesser cusps on each side, with the largest lesser cusp separated from the major cusp by two small lesser cusps, while in the teeth towards the angle of the jaw there is a reduction in the number of lesser cusps to one or two on each side. Three series of upper teeth functional at the centre of the jaw, two towards the angles. The lower teeth blade-like, each with a smooth, little-sculptured, rectangular base almost twice as high as broad, and bearing a single, smooth-edged, triangular cusp. Each cusp is sharply notched laterally, strongly oblique, and overlaps the adjacent cusp so that an almost continuous cutting edge is formed. There is no median tooth, and the base of the first tooth on the left side overlaps that of the first tooth on the right. A single series of lower teeth functional.

First dorsal small, short-based, and brush-shaped, its distance from snout tip 33.4 per cent of the total length. Height of first dorsal 1.9 in its base, and the latter 4.6 in the interspace between the first and second dorsals. Length of the posterior margin 1.5 in the length of the base; the posterior tip sharply pointed. The first dorsal spine short and almost straight, its length less than half the distance from its origin to the first dorsal apex. Interspace between the first and second dorsals equal to the distance from snout tip to the axil of the pectoral. Second dorsal considerably larger than the first, and originating above the posterior insertion of the pelvic base. Height of the second dorsal 2.0 in its base, and the latter 3.2 in the interspace between the dorsals. The second dorsal spine strongly curved and long, its length 2.5 times that of the first dorsal spine. Interspace between second dorsal and caudal 3.0 in that between first and second dorsals. Caudal measured from hypural origin 5.0 in

the total length. Height of the epiural 4.6 in its length, and its margin slightly sinuous. The terminal lobe with a convex margin. Height of the hypural 1.7 times that of the epiural, and its lower anterior margin almost straight. The apex acutely angled, and the posterior margin deeply concave. The pectorals short and wide, their length 2.0 in the head measured to the first gill-opening, and their width 1.4 in their length. The anterior margin almost straight, the posterior margin slightly convex and continued without a distinct angle into the distal margin. Pelvics originating anterior to the second dorsal origin by a distance equal to the length of the pectoral. Length of pelvic base equal to that of second dorsal base; posterior margin short, its length 2.5 in the horizontal diameter of the eye. The posterior tip of pelvic pointed, and terminating just anterior to the origin of the second dorsal spine.

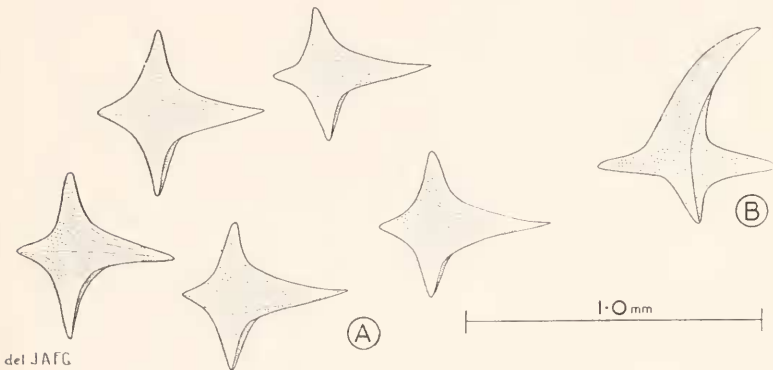


Figure 2. *Etmopterus baxteri* n.sp., holotype, 742 mm. total length. A, external view of dermal denticles from high on side at level of 1st dorsal; B, lateral view.

Colour. The overall colour of the specimen is an almost uniform, medium dusky brown, slightly darker on the ventral surface and on the fins, but considerably lighter in the regions which are smooth and free of denticles, such as the axils of the fins, and the lips. There is also a vertical white band devoid of pigment on the anterior surface of the outer part of each gill-arch, though this is visible only on the first arch where the anterior edge of the first gill-opening is strongly emarginate. Despite the ap-

parent uniformity of colour of the specimen, close examination reveals the presence of well-defined, darker regions which contribute to a pattern similar to that described for other etmopterids. These darker regions are characterised in this specimen chiefly by the presence of numerous small, black pits, rather than by an increase in the number of typical chromatophores. The black pits are not, however, confined to the darker regions, but are distributed more sparsely over the entire head, trunk and fins. The most prominent dark region is a longitudinal flank mark above the pelvic fin, and of the shape shown in Figure 1A. As described above, within the area encompassed by this flank mark, the dermal denticles are smaller and directed more ventrally than those outside it, so that they also contribute to its definition. The pelvic flank marks are connected on the ventral surface of the caudal peduncle where they form a pattern as in Figure 1C. The ventral surface of the abdomen is also a distinct dark region, well delineated on the flanks by a denser concentration of black pits along its edges than elsewhere on the ventral surface. Anteriorly it is continued under the head and snout, but apart from an ill-defined transverse band under the head, its extent is not clear. Other dark marks present are a narrow, curved band on the lower surface of the pectoral fin, extending from the origin of the fin to its insertion; a short streak on the anterior margin of each dorsal fin, close to the tip of each dorsal spine; and a prominent, dark line near the tip of the caudal axis, parallel to and just below the terminal portion of the lateral line where the latter is in the form of a naked groove. The last-mentioned mark is contributed to not only by black pits, but also by a very thin black streak along each edge of the lateral line groove. A very few similar black streaks are also present sporadically on the sides of the trunk, where they are short and appear to be derived from the fusion of contiguous black pits. The lining of the mouth is a light dusky brown, as is the lining of the body cavity.

Luminescence. The black pits which contribute most of the colour pattern to the specimen, and the few black streaks which are present, appear to be identical with those of *E. spinax* in which they are known to be luminescent. However, Mr. Baxter did not notice any luminescence on the specimen when it was

first taken from the water, though this was during daytime when such luminescence might not be obvious.

Maturity. The adult condition of the specimen is evidenced by the extrusion of two embryos during its transport from Kaitioura to Wellington. The embryos are two inches long, devoid of pigment, and only part way through development. They were attached to large yolk-sacs, though these were ruptured and could not be measured. At least two other intact yolk-sacs can be felt within the animal, and possibly others may be present but ruptured.

Discussion. The thorn-like denticles of *E. baxteri* readily distinguish it from those species of *Etmopterus* with truncate denticles, i.e. *frontimaculatus*, *pusillus* and *granulosus*, as they do also from *paessleri* which is described as having denticles with a larger central spine surrounded by several lesser spines. Of the remaining etmopterids, all of which have denticles with a single spine, four more are separable from *baxteri* on denticle characters — namely, *virans*, in which the denticles are thorn-like but very short and low, and *spinax*, *hillianus* and *schultzi*, which have elongate, bristle-like denticles; though as the differences between these species and *baxteri* in this respect are less distinctive than those between *baxteri* and the species with truncate or multispinose denticles mentioned above, it is perhaps better not to rely on them alone as primary specific characters.

Compared with *virans*, *baxteri* is heavy-bodied and short-tailed (the distance from pelvic origin to tip of caudal 42.6 per cent of the total length in *baxteri*, 53 per cent in *virans*). From *villosus*, *baxteri* differs in the very much shorter predorsal length (equal to less than the distance from origin to origin of the first and second dorsals in *baxteri*, but reaching from first dorsal origin to almost the upper caudal origin in *villosus*). The two noticeably short-tailed Pacific species, *brachyurus* from the Philippines and *molleri* from southern Australia, differ from *baxteri* not only in their short-tailedness (the length of the upper caudal margin two-thirds and three-fourths of the distance from the rear ends of the pelvic bases to the lower caudal origin in *brachyurus* and *molleri* respectively, but more than one and a third times in *baxteri*) but also in the linear arrangement of the denticles on the sides of their trunks; their proportionately longer pectoral fins (reaching to the first dorsal when laid back

in *brachyurus* and *molleri*, but falling well short of this level in *baxteri*); and their more attenuate pelvic flank marks. The same differences apply between *lucifer* and *baxteri*, though in *lucifer* the length of the upper caudal margin is proportionately longer than in *brachyurus* or *molleri* but still considerably shorter than in *baxteri*.

Of the etmopterids with bristle-like denticles, i.e. *schultzi*, *hillianus* and *spinax*, *schultzi* is clearly distinct from *baxteri* not only in its very elongate caudal fin (the upper margin of the caudal almost equal to the distance from snout tip to the tip of the pectoral when the latter is laid back in *schultzi*, but reaching only to the second gill-opening in *baxteri*) but also in its peculiar frayed and fringe-like fin margins which differ from those of all other etmopterids. *E. hillianus* has a greater peduncular length than *baxteri* (the distance from the rear ends of the pelvic bases to the lower caudal origin as long as the distance from snout tip to pectoral origin in *hillianus*, but reaching only midway between spiracle and first gill-opening in *baxteri*); while *spinax* is readily separable from *baxteri* by its much narrower head (head width equal to the preoral distance in *spinax*, but more than one and a half times this distance in *baxteri*); its shorter and less concave gill-openings; and the shape of the dark markings on the ventral surface of the trunk and peduncle.

The remaining etmopterids to be compared with *baxteri*, i.e. *polli* and *princeps*, both agree with this species in being more or less plain and dark coloured, and in having thorn-like denticles which are in random but uniform arrangement. *E. polli*, however, is distinctive in having a short interdorsal space (reaching much less than the distance from snout tip to first gill-opening in *polli*, but extending to the axil of the pectoral in *baxteri*) and a longer pectoral which reaches behind the base of the first dorsal spine when laid back. In *baxteri* and *princeps* the pectorals are short, their tips failing to reach the first dorsal origin, while further agreement between these species is seen in the noticeable broadness of the head, the long and concave gill-openings (which expose the lamellae of the first gill-arches), and the vertical white markings on the outer part of the gill-arches.

E. baxteri differs from *princeps* in having a shorter tail (the length from pelvic origin to tip of caudal equal to distance from

snout tip to posterior tip of the first dorsal fin in *baxteri*, but reaching to midway between first dorsal tip and pelvic origin in *princeps*); a shorter caudal fin (the upper caudal margin reaching from snout to second gill-opening in *baxteri* but from snout tip to pectoral origin in *princeps*); a more conspicuous and differently shaped pelvic flank mark; less oblique nostrils; and upper teeth mostly with 7 or 9 cusps rather than the 5 cusps in *princeps*. Moreover the arrangement of the lesser cusps of the upper teeth in *baxteri*, where a very small lesser cusp is sandwiched between a larger lesser cusp and the major cusp, differs from that in not only *princeps* but also all other etmopterids where the lesser cusps usually diminish uniformly in size from the major cusp outwards.

ETMOPTERUS ABERNETHYI n.sp.

Figures 3 and 4

Study Material. Holotype, immature male, 338 mm. total length, Dominion Museum No. 1951; and paratype, female, 278 mm. total length, Mus. Comp. Zool. No. 39714; both lined by Mr. Richard Baxter from 7 miles south of Kaikoura, the holotype from 200 fathoms in November, 1955, the paratype from 100 fathoms in February, 1956.

Description. *Proportional measurements in per cent of total length:* Holotype and paratype.

Trunk at pectoral origin: breadth, 10.4-11.1; height, 8.6-8.6.

Snout length in front of: outer nostrils, 2.7-2.5; mouth, 10.9-11.5.

Eye: horizontal diameter, 4.6-5.0; vertical diameter, 2.7-2.9.

Mouth: breadth, 5.9-6.1; height, 1.2-1.1.

Nostrils: breadth (between inner corners), 3.0-3.2

Labial furrow lengths: upper, 3.3-3.2; lower, 1.5-1.4.

Gill-opening lengths: 1st, 1.3-1.3; 5th, 1.0-1.1.

First dorsal fin: vertical height, 3.3-4.0; length of base, 5.6-6.5.

Second dorsal fin: vertical height, 5.6-6.1; length of base, 8.0-8.6.

Caudal fin: upper margin, 22.5-23.0; lower anterior margin, 10.9-10.4.

Pectoral fin: anterior margin, 9.5-9.7; width, 8.3-9.3

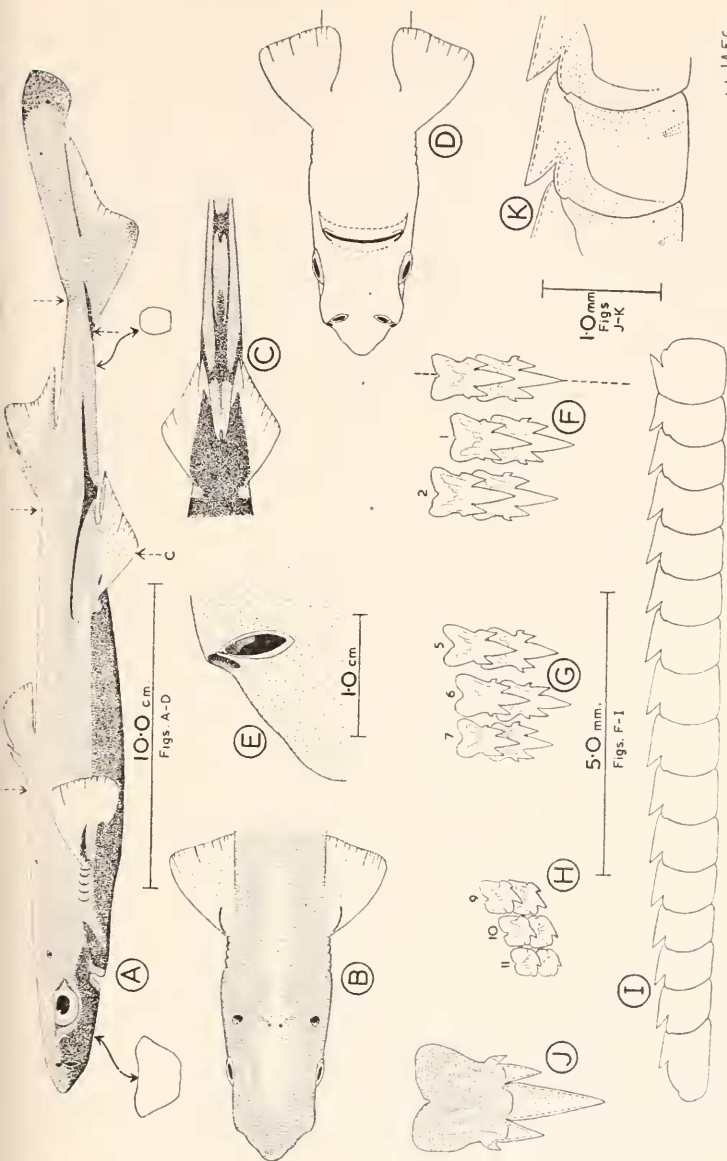
Pelvic fin: anterior margin, 7.1-6.8; distal margin, 6.8-9.0.
Distance from snout to: eye 6.5-7.2; 1st gill-opening, 18.7-19.0;
5th gill-opening, 21.9-23.0; 1st dorsal, 29.6-32.0; 2nd dorsal,
57.0-57.9; upper caudal, 77.5-77.0; pectoral, 22.2-23.4; pel-
vic, 48.2-49.4.

Interspace between: 1st and 2nd dorsals, 21.6-19.8; 2nd dorsal
and caudal, 12.7-11.9.

Distance from origin to origin of: pectoral and pelvic, 26.3-
27.1; pelvic and subcaudal 27.1-26.3.

Head depressed, long, and very large-eyed; trunk moderately slender, and compressed posterior to the pectorals. Height of trunk at origin of pectorals 8.7 in the length from snout tip to origin of subcaudal. Length of body measured to the cloaca, 53 per cent of the total length. Caudal peduncle little compressed and slender, and without lateral keels or precaudal pits.

Dermal denticles small, slender and thorn-like, borne on four-angled bases and with their tips directed slightly posteriorly. Each denticle is six-ridged, as in *E. baxteri*, though the ridges are less steep and fail to extend to the tip of the denticle. The denticles are numerous, and well-spaced; arranged in random on the ventral surface of the head and trunk, but in distinct parallel longitudinal rows on the sides and upper surface, the fins, and the venter of the peduncle. Above the lateral line, the rows are oblique, sloping posterodorsally on the head and in front of the first dorsal fin, but with their slope flattening out and reversing behind the latter level. Below the lateral line, the rows are horizontal. The line of demarcation between the linear arrangement of the denticles on the sides and the random arrangement below, is sharp, and parallels that of the dark colour pattern; it skirts the lateral margin of the snout, follows round the lower edge of the eye, runs beneath the gill-openings, and is especially prominent from the axil of the pectoral to the origin of the pelvic. Within the lateral pelvic flank mark, the denticles are more sparsely distributed, are noticeably smaller, and have their tips directed ventrally rather than posteriorly. The distal parts of the webs of the dorsal, pectoral and pelvic fins are naked, as are the terminal and hypural lobes of the caudal fin. Other naked areas include the upper and lower lips; the interspaces between the gill-openings; and the axils of the pectoral, pelvic and dorsal fins (though none of the latter is as extensive as in *E. baxteri*).



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Figure 3. *Elanopterus abnormethyi* n.sp., holotype, 338 mm, total length. A, lateral view and insets of sections through snout and peduncle; B, dorsal view of head showing extensive pale regions; C, ventral view of peduncle; D, ventral view of head; E, left nostril; F-K, paratype, 278 mm, total length; F-H, upper teeth from right side, row numbers indicated above; I, lower teeth from right side; J, 3rd upper tooth, right side; K, 4th lower tooth, right side. (c = level of cloaca.)

Head measured to first gill-opening 5.3 in the total length, and about two-thirds of the distance from snout tip to first dorsal origin. Head long, flat above, and with little change in width from the level of the spiracles to the level of the nostrils. Inter-orbital width 1.4 in the preoral distance. The snout contours rapidly taper at the level of the nostrils so that the snout tip is prominently pointed. In lateral view the snout is of almost equal thickness from the hind level of the eyes to the nostrils, though anterior to the latter the profile angles steepen to form the bluntly wedge-shaped snout tip. Length of snout, measured to eye, 2.9 in the head. Eye large, ovoid, nearly twice as long as high; its horizontal diameter 1.4 in the snout. Spiracle large, its length just less than one quarter of the horizontal diameter of the eye, and placed just above the eye and behind it by a distance equal to one and a half times its own length. Gill-openings small, each vertical but concave, their lengths subequal and about 4.0 in the eye. Interspaces between the gill-openings decrease slightly posteriorly. Nostrils large, oblique, and well anterior on the venter of the snout. Each nasal aperture subdivided by triangular nasal flaps into a circular, anterolateral aperture facing to the anterior, and an ovoid posteromedial aperture which is margined in front and behind by a low membrane. The anterior nasal flap is attenuate, sharply pointed, and external to the short fleshy posterior flap. Mouth broad and little arched, its width 1.5 in the preoral distance, the latter 1.7 in the head. The upper labial furrows deeply incised anteriorly, their length equal to the distance from their anterior extremities to the symphysis of the upper jaw, and arranged so that one-third is anterior to the angle of the jaw and two-thirds is posterior. The lower labial furrows are shallowly incised and short, their length less than half that of the upper furrows.

Teeth $\frac{11-1-11}{18-17}$ in the male of 338 mm., $\frac{10-1-11}{16-15}$ in the female of 278 mm., dissimilar in the two jaws. The upper teeth erect, multi-cusped, each with a long, sharply-pointed, awl-shaped, smooth-edged major cusp flanked on each side by one or two lesser cusps, and borne on a longitudinally-striated base. Most of the upper teeth have two lesser cusps on each side of the major cusp, with the outer cusp of these two very much smaller than the inner which is one-third to one-half of the length of the major cusp.

The teeth towards the angle of the jaw have only one or no lesser cusps on each side. Three series of upper teeth functional at the centre of the jaw, two towards the angles. The lower teeth blade-like, each with a smooth-faced, subrectangular, laterally-rounded base, bearing a single, smooth-edged triangular cusp. Each cusp is sharply notched laterally, very strongly oblique, and overlaps the adjacent cusp so that an almost continuous cutting edge is formed. There is no median tooth, and the base of the first tooth on the left side overlaps that of the first tooth on the right. A single series of lower teeth functional.

First dorsal small, brush-shaped, originating just anterior to the tip of the pectoral when the latter is laid back. Distance from snout tip to first dorsal origin 29.6 per cent to 32.0 per cent of the total length. Height of first dorsal 1.7 in its base, and the latter 3.8 in the interspace between the first and second dorsals. Length of the posterior margin 1.3 in the length of the base, and the posterior tip pointed. The first dorsal spine short and almost straight, its length less than half the distance from its origin to the apex of the fin. Interspace between the dorsals equal to or less than the distance from snout tip to pectoral origin. Second dorsal much larger than the first, originating just posterior to the rear insertion of the pelvic base. Height of the second dorsal 1.5 in its base, and the latter 2.7 in the interspace between the dorsals. The second dorsal spine curved and long, reaching two-thirds of the distance from its origin to the apex. Interspace between second dorsal and caudal 1.8 in that between first and second dorsals. Caudal measured from hypural origin 4.0 in the total length. Height of the epidual 6.5 in its length, and its margin straight along most of its length but convex distally. The terminal lobe with a convex margin. Hypural originates well anterior to the epidual, its height 1.6 times that of the latter. Anterior margin of hypural straight, the apex right-angled but rounded, and the posterior margin concave. Pectorals noticeably wide, their width 1.2 in their length, and the latter 2.3 in the head. Anterior and posterior margins convex, distal margin straight, and the posterior angle smoothly rounded. Pelvics originating well anterior to the second dorsal, the interspace between first dorsal tip and pelvic origin equal to the length of the pelvic base. Anterior and distal margin straight, and the apex prominent but rounded.

The posterior tip sharply pointed and terminating at the level of the second dorsal spine. Claspers on holotype cylindrical in section, tapering to a point posteriorly, and showing no sign of the external features which might be expected in a mature animal.

Colour. Dusky dark brown above, black below, though a heavy coating of mucus gives the specimens a greyish cast. Dorsal, pectoral and pelvic fins pale and translucent, as is the lower posterior margin of the caudal. A large, ovoidal pale area covers the greater part of the top of the head, and posteriorly is continued as a wide band along the mid-dorsum of the trunk and peduncle, though it is interrupted at the dorsal fins, the bases of which are dusky brown. There is also a pale supraorbital streak on each side of the head; a narrow indistinct pale band along the lateral line; and an elongate pale mark above and anterior to the pelvic origin. In the female of 278 mm., the pale markings are more extensive than in the holotype; the mid-dorsal band extending well down the sides of the peduncle, and the epiural lobe as well as the hypural lobe is pale, though the terminal lobe and the apex of the hypural are darker than elsewhere on the caudal axis as is also the case in the holotype.

Microscopic examination shows that the darkness of the ventral surface is due not only to a greater number of chromatophores compared with the condition on the sides and upper surface, but also to the presence of numerous small black pits, as in *E. baxteri*. The dark regions thus characterised include the undersurface of the snout, head and trunk (the demarcation line between the dark region below and the lighter region above well delineated by a greater concentration of black pits than elsewhere on the undersurface — see Figure 4C); the venter of the peduncle where a pattern is present as in Figure 3C, though this pattern is not developed as clearly in the female of 278 mm.; an attenuate pelvic flank mark of the shape shown in Figure 3A; a long, narrow caudal streak parallel to and below the naked, grooved portion of the lateral line; a large curved streak on the underside of the pectoral, and a short arc on its upper surface; and a short streak on the upper surface of the pelvic base. There is also a prominent row of black pits and streaks along the mid-dorsal line, while others are scattered over most of the head and the

trunk where their concentration and arrangement is similar to that known in *E. lucifer*. Lining of mouth dusky grey; lining of body cavity black.

Luminescence. It is not known if *E. abernethyi* is luminescent, for although the black pits and streaks present resemble closely those of luminescent species of *Etmopterus*, no luminescence was observed in the specimens when they were caught.

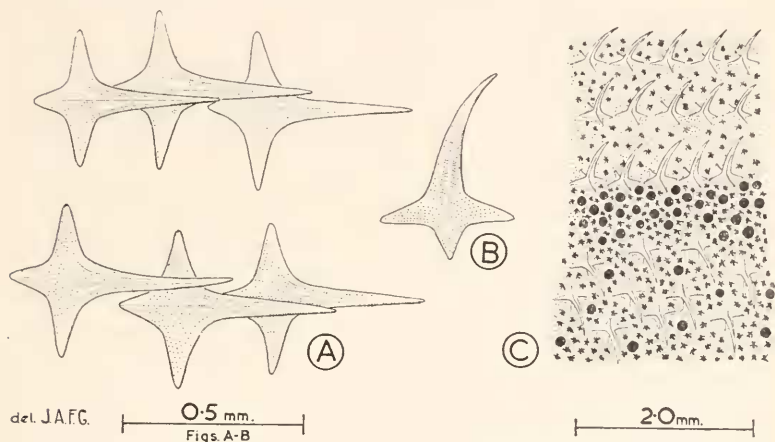


Figure 4. *Etmopterus abernethyi* n.sp., holotype, 338 mm. total length. *A*, external view of denticles from high on side at level of 1st dorsal; *B*, lateral view; *C*, external view of skin from lower part of side of trunk, showing three rows of denticles arranged linearly, and others below arranged at random. Note greater concentration of chromatophores in lower half, and black pits which are most numerous at demarcation line between light and dark regions.

Maturity. The claspers on the holotype lack the external spurs which might be expected in a mature specimen; the female of 278 mm. has not been examined for its state of maturity though its small size in comparison with the immature male suggests that it, too, is immature.

Discussion. As in *E. baxteri*, the thorn-like denticles of *E. abernethyi* provide a ready character for the separation of this species from *frontimaculatus*, *pusillus* and *granulosus* which have truncate denticles, and from *paessleri* in which the denticles are

multispinose. The slender thorns of *abernethyi* are also obviously distinct from the short, low denticles of *virens*, though in other respects including the general proportions of the body, *abernethyi* is strikingly similar to this species. It differs from *virens* in the relatively shorter peduncular length (the distance from the rear ends of the pelvic bases to the lower caudal origin equal to the distance from snout tip to first gill-opening in *abernethyi*, but reaching to the pectoral origin in *virens*); in the lack of the transverse pale markings on the abdomen; in the presence of the conspicuous mid-dorsal pale band; and in the shape of the dark pelvic flank mark and the ventral peduncular dark marks. *E. abernethyi* differs from *villosus* in the much shorter predorsal length (just greater than the distance from origin to origin of the first and second dorsals in *abernethyi*, but reaching from first dorsal origin to almost the upper caudal origin in *villosus*).

The etmopterids with bristle-like denticles differ less from *abernethyi* in their denticle shape than they do from *baxteri* which has shorter and less slender denticles than *abernethyi*. But *schultzi* with its very elongate caudal (the upper margin of which is about equal to the distance from snout tip to tip of pectoral when the latter is laid back) and its fringed fins cannot be confused with *abernethyi* whose upper caudal margin is just greater than the length of head measured to the pectoral and whose fins are not frayed more than is usual in other etmopterids. *E. hillianus* differs from *abernethyi* not only in its bristle-like denticles, as does *spinax*, but also in its greater peduncular length (distance from rear ends of bases of pelvics to origin of lower caudal equal to distance from snout tip to pectoral origin in *hillianus*, but only to first gill-opening in *abernethyi*); the shape of the pelvic flank mark and the ventral peduncular mark; and the prepelvic transverse pale band which is lacking in *abernethyi*. *E. spinax* has a peduncular length similar to *abernethyi*, but differs in its random arrangement of bristle-like denticles, and its colour patterns including the shape and extent of the pelvic and peduncular dark marks.

E. polli, *princeps* and *baxteri* have denticles only slightly stouter than those of *abernethyi*, but like *spinax*, these are arranged in random (at least anterior to the caudal peduncle) and thus markedly different to the linear arrangement in *abernethyi*.

The pelvic flank marks of *polli* and *baxteri* are much less elongate than those of *abernethyi*, while the short interdorsal space of *polli* (equal to less than the distance from snout tip to first gill-opening in *polli*, but extending to the pectoral origin in *abernethyi*) and the short stubby pectoral fins of *princeps* and *baxteri* (failing to reach the first dorsal origin when laid back) clearly distinguish these species from *abernethyi*.

The remaining three etmopterids, *brachyurus*, *molleri* and *lucifer*, all agree fairly closely with *abernethyi* in their overall proportions, their colour patterns (excluding the extensive mid-dorsal pale band which seems to be characteristic of *abernethyi*), and the nature and arrangement of their denticles. But *brachyurus* and *molleri* are short-tailed species, the lengths of their upper caudal margins reaching only two-thirds and three-fourths of the distance from the rear ends of the pelvic bases to the lower caudal origins, while in *abernethyi* the upper caudal margin is one and a quarter times this distance. Moreover, in lateral view both *brachyurus* and *molleri* are noticeably more sharp-snouted species, the upper and lower profiles of the head tapering smoothly to the snout tip. *E. abernethyi* is less sharp-snouted, the head profiles little tapered from the eyes to the nostrils but steepening rapidly from the nostrils anteriorly, where a distinct change in the angles is evident. *E. lucifer* is intermediate between *abernethyi*, and *brachyurus* and *molleri* in the length of its upper caudal margin (which is equal to the distance from the rear ends of pelvic bases to the origin of lower caudal), but differs from *abernethyi* in having a greater peduncular length (distance from rear ends of pelvic bases to origin of lower caudal equal to distance from snout tip to pectoral origin in *lucifer*, but reaching only to first gill-opening in *abernethyi*); a shorter snout (equal to or less than the length of the eye in *lucifer*, but 1.5 times the eye-length in *abernethyi*); a different dark pattern on the undersurface of the peduncle; and the lack of the extensive mid-dorsal pale band which is so prominent in *abernethyi*.

LITERATURE CITED

BIGELOW, H. B., W. C. SCHROEDER, AND S. SPRINGER

1953. New and little known sharks from the Atlantic and from the Gulf of Mexico. *Bull. Mus. Comp. Zool.*, **109** (3): 213-276, figs. 1-10.

WHITLEY, G.

1939. Studies in ichthyology no. 12. *Rec. Australian Mus.*, **20** (4): 264-277.